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THE WORK OF THE HUNTLEY RECLAMATION PROJECT EXPERIMENT FARM IN 1918

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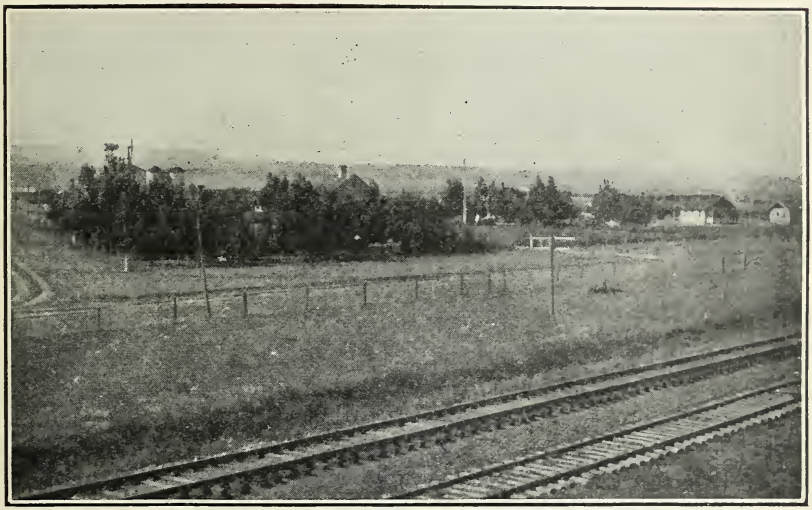
By DAN HANSEN
Farm Superintendent



Buildings on the Huntley Experiment Farm in 1918.

UNITED STATES DEPARTMENT OF AGRICULTURE
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CONDITIONS ON THE PROJECT.

CROP CONDITIONS.

The crop season of 1918 at the Huntley Reclamation Project Experiment Farm was in most respects very favorable. Spring planting was accomplished in good season, conditions being excellent for starting crops, and irrigation was not required until the crops were well established. On a part of the land that is watered by what is known as the high-line ditch, crops were damaged to a slight extent by hail during July. A rather general invasion of the sugar-beet webworm occurred during August, and the yield of beets was affected somewhat from this cause.

There was a notable decrease in 1918 in the sugar-beet acreage on the project and a corresponding increase in the acreage planted to wheat, due largely to the relative difference in prices paid for these two crops. Sugar beets were grown on 1,963 acres and wheat on 6,306 acres, while the average for the previous five years was 4,556 acres cropped to beets and 2,530 acres cropped to wheat. The yields of alfalfa were good, and the quantity produced was much more than was required for feeding stock kept throughout the year on farms. There was not much winter feeding of range stock, and the surplus hay was shipped out. The local farm price of hay was about $15 a ton in the stack.

The acreage, yields, and farm values of crops produced on the Huntley project in 1918, according to figures furnished by the United States Reclamation Service, are given in Table I.

TABLE I.—*Acreage, yields, and farm values of crops produced on the Huntley Reclamation Project in 1918.*

Crop.	Area (acres).	Unit of yield.	Yields.			Farm values.		
			Total.	Per acre.		Per unit of yield.	Total.	Per acre.
				Average.	Maximum.			
Alfalfa hay	6,766	Ton	17,234	2.55	5	$11.99	$206,712	$30.57
Alfalfa seed	49	Bushel	178	3.67	16	12.20	2,170	44.75
Barley	75	do	1,883	25.11	54	.98	1,854	24.71
Beans	128	do	955	7.47	35	4.52	4,320	33.80
Beets, sugar	1,963	Ton	16,299	8.30	28	10.00	162,990	83.00
Cane	25	do	67	2.73	7	10.00	670	27.34
Clover hay	45	do	124	2.74	4	12.06	1,490	33.33
Clover seed	224	Bushel	354	1.58	6	11.20	3,958	17.68
Corn	203	do	4,263	21.20	60	1.25	5,381	26.50
Millet	4	do	70	20.00	20	4.00	280	80.00
Garden	199						15,770	79.30
Hay [1]	108	Ton	139	1.29	5	11.90	1,650	15.27
Oats	2,006	Bushel	73,080	36.43	106	.79	57,899	28.86
Pasture	1,091						10,588	9.70
Potatoes	73	Bushel	9,612	132.12	400	.69	6,616	90.93
Wheat	6,306	do	138,305	21.93	50	1.94	268,616	42.60
Total	19,265						750,964	
Average								39.00

[1] Hay other than alfalfa and clover.

LIVE STOCK.

The number of live stock of all kinds kept on farms remained practically the same as in 1917 except that there was a decrease in the number of sheep brought in for winter feeding. Sheep are fed mainly only for a short period after beet harvest and during the winter months, and the fact that the beet acreage was comparatively light and the price of alfalfa high was probably responsible for the decreased number of sheep that were fed.

The number and value of all live stock on the project are given in Table II.

TABLE II.—*Live stock on the Huntley Reclamation Project in 1918.*

Item.	Inventory, Jan. 1.			Inventory, Dec. 31.			Increase or decrease in total value.
	Number.	Average value.	Total value.	Number.	Average value.	Total value.	
Horses	2,145	$131.73	$282,570	2,120	$108.70	$230,435	−$52,135
Mules	80	134.56	10,765	51	107.16	5,465	− 5,300
Cattle:							
Beef	1,795	45.71	82,060	1,813	51.03	92,517	10,457
Dairy	1,949	54.02	105,290	1,923	60.18	115,726	10,436
Sheep	1,974	8.13	16,064	1,130	13.41	15,153	911
Hogs	2,363	15.40	36,363	2,391	18.07	43,205	6,840
Fowls	16,418	.54	10,343	15,856	.52	8,245	− 2,098
Bees, hives	282	3.33	940	424	3.78	1,603	663
Total			544,397			512,349	− 32,048

CLIMATIC CONDITIONS.

The total precipitation for 1918 amounted to 13.46 inches, while the average for the past eight years, as recorded at the experiment farm, was 14.19 inches. The winter precipitation was unusually high, so that the soil was well supplied with moisture at the beginning of the growing season. During the first part of the growing season the rainfall was slightly below normal. The frost-free period extended from May 21 to October 7, or 138 days, which was 10 days longer than the average for eight years. Severe freezing occurred during the latter part of October and early in November, which occasioned some difficulty in harvesting sugar beets.

Table III gives a summary of the climatological observations as recorded at the Huntley Experiment Farm from 1911 to 1918, inclusive.

TABLE III.—*Summary of climatological observations made at the Huntley Experiment Farm, 1911 to 1918, inclusive.*

PRECIPITATION (INCHES).

Item.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Average for 8 years, 1911 to 1918	0.69	0.22	0.66	0.91	2.39	2.67	1.37	0.84	1.55	1.38	0.72	0.80	14.19
For 1918	2.42	.33	.59	.67	2.09	1.20	1.29	1.18	1.87	.53	1.20	.09	13.46

EVAPORATION (INCHES).

Average for 8 years, 1911 to 1918	.....	.....	.....	3.296	4.614	6.086	7.432	6.743	4.188	.....	.....	.....	31.533
For 1918	.....	.....	.....	3.126	4.968	7.441	6.590	7.149	3.233	.....	.....	.....	32.507

DAILY WIND VELOCITY (MILES PER HOUR).

Highest:													
1911 to 1918	12.5	9.9	10.5	12.4	11.4	7.4	7.0	6.2	8.7	9.0	10.6	13.8	.....
For 1918	11.2	6.3	7.7	12.3	10.0	6.6	5.9	5.7	8.1	7.0	9.2	10.6	.....
Lowest:													
1911 to 1918	.8	1.2	1.1	1.9	1.8	1.7	1.2	1.2	.9	1.3	.9	.9	.....
For 1918	.6	1.3	.5	1.2	2.4	.4	1.2	1.9	.9	1.0	.6	1.0	.....
Mean:													
1911 to 1918	5.2	4.9	4.7	5.4	5.1	4.1	3.4	3.3	3.7	4.0	4.0	5.0	.....
For 1918	3.8	3.7	2.5	5.9	5.1	3.4	2.6	3.5	3.0	3.4	3.2	3.4	.....

TEMPERATURE (°F.).

Absolute maximum:													
1911 to 1918	55	53	66	79	88	93	98	97	91	81	65	55	.....
For 1918	64	50	73	76	90	103	100	100	88	81	60	60	.....
Absolute minimum:													
1911 to 1918	−26	−20	−8	19	28	38	42	40	29	13	0	−15	.....
For 1918	−36	−31	−1	18	30	43	38	41	33	20	−17	−13	.....
Mean:													
1911 to 1918	16	20	32	45	53	63	70	68	55	45	34	22	.....
For 1918	15	22	40	41	53	69	69	67	56	50	26	29	.....

TABLE III.—*Summary of climatological observations made at the Huntley Experiment Farm, 1911 to 1918, inclusive*—Continued.

KILLING FROSTS.

Year.	Last in spring.		First in autumn.		Frost-free period.
	Date.	Minimum temperature.	Date.	Minimum temperature.	
		° F.		° F.	*Days.*
1911	May 26	32	Sept. 18	28	114
1912	May 12	28	Sept. 15	31	125
1913	May 5	31	Sept. 19	29	136
1914	May 12	32	Oct. 6	31	146
1915	May 21	32	Sept. 19	32	120
1916	May 16	30	Sept. 13	31	119
1917	May 31	31	Sept. 28	32	119
1918	May 21	32	Oct. 7	28	138
Average	May 18		Sept. 23		127

THE WORK OF THE EXPERIMENT FARM.[1]

The work of the Huntley Experiment Farm includes experiments in the production and utilization of crops both under irrigation and on dry land, although the major part of the farm is under irrigation. This report deals only with the results of the experimental work on the irrigated part of the farm. This work includes: (1) Crop rotations, (2) experiments with pasture grasses, (3) pasturing experiments with hogs and dairy cattle, (4) cropping methods, (5) tests of crop varieties, (6) experiments with sugar beets, and (7) experiments with fruit trees and small fruits. Experiments on the dry land include crop rotation and tillage methods, variety testing of crops, and pasturing experiments with hogs. The arrangement of the fields and the locations of the principal experiments in 1918 are shown in figure 1.

In cooperation with the Bureau of Animal Industry of the Department of Agriculture and the Montana Agricultural Experiment Station experiments were begun with hogs in 1917 and in 1918 with dairy cattle. The work with hogs in 1917 and 1918 included the testing of varying quantities of grain as supplemental feed with alfalfa pasture and the comparative value of different feeds in finishing hogs for market. The dairy herd consists of 10 pure-bred Holstein cattle and 10 grade cows. Pasturing experiments with three different pasture mixtures[2] were conducted during the season, and later

[1] The Huntley Experiment Farm is located on the Huntley Reclamation Project, near the town site of Osborn, Mont. It comprises about 300 acres of public land, of which about 140 acres lie above the irrigation canal. The work of the farm is under the supervision of the Office of Western Irrigation Agriculture. The Office of Dry-Land Agriculture, the Biophysical Laboratory, and other offices of the Bureau of Plant Industry, the Dairy Division and the Animal Husbandry Division of the Bureau of Animal Industry, and the Montana Agricultural Experiment Station are cooperating in the investigational work.

[2] The experiments here reported (pp. 25–32) are incidental to the work in breed improvement and feeding dairy animals conducted on the Huntley Experiment Farm by the Dairy Division of the Bureau of Animal Industry. While the data here presented are incomplete and unsatisfactory in some respects, they clearly establish the major fact that mixed-grass pastures on the Huntley Reclamation Project give excellent returns in terms of milk and butter fat.

a feeding experiment was conducted to compare the value of corn and sunflower silage.

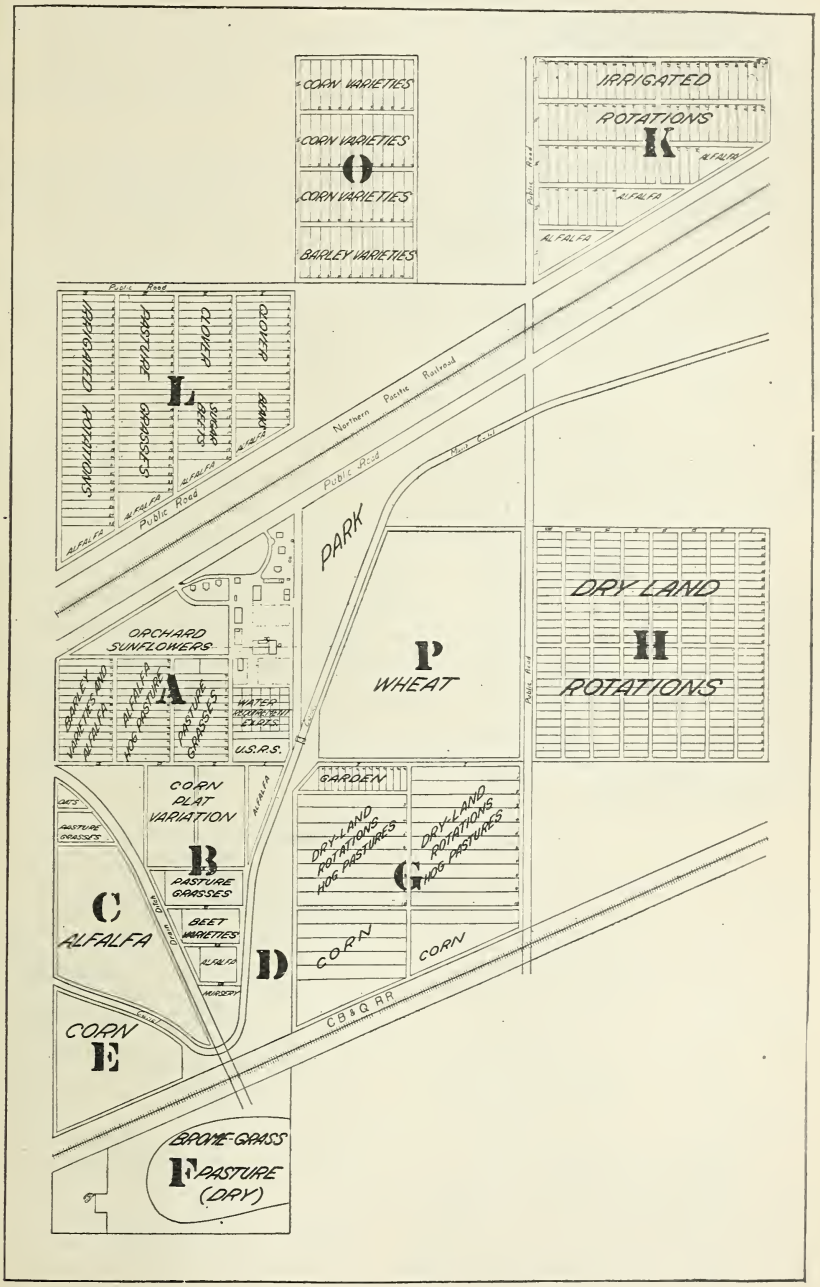

FIG. 1.—Diagram showing the arrangement of the fields and the location of the experiments at the Huntley Experiment Farm in 1918.

FIELD-CROP EXPERIMENTS.

CROP-ROTATION EXPERIMENTS.

A rotation experiment with irrigated crops has been conducted at the Huntley Experiment Farm since 1912. Field K, containing 70 plats, was first used for this work. In 1916, an additional series of rotations was started on 27 plats in field L–IV. All plats in these two fields are one-quarter of an acre in size.

The chief purpose of this experimental work with crop rotations is to determine quantitatively which of the crop sequences are the most favorable for the production of the various crops and also to ascertain the value of manuring. It is generally believed that a rotation of crops and the use of farm manure are beneficial, but there is very little definite knowledge as to just how helpful they are or, in other words, whether crop rotation or manuring is really worth while on these newly irrigated lands.

Each crop is planted on the various plats at the same time, the same variety of seed is used on all plats, and all plats of the same kind of crop are given identical cultural treatments, so that the differences in yields must be due to the differences in the plats. These variations in yields from plats on which the same crop is planted may be due in part to soil variation and in part to the effect of the preceding crop, or, in certain cases, to manuring. During the early years of this experiment soil variation was doubtless an important factor, and an exact statement regarding its effect upon crop yields can not be made, but as time goes on it will be possible to analyze the results in such a way as to reduce this factor materially.

The rotations and their cultural treatments in these experiments are listed as follows:

ROTATIONS BEGUN IN 1912, FIELD K.

No. 1.—Oats (continuously cropped), fall plowed.
No. 2.—Beets (continuously cropped), fall plowed.
No. 3.—Wheat (continuously cropped), fall plowed.
No. 4.—Potatoes (continuously cropped), fall plowed.
No. 5.—Wheat (continuously cropped), fall plowed.
No. 6.—Corn (continuously cropped), fall plowed.
No. 7.—Wheat (continuously cropped), straw returned each year, fall plowed,
No. 8.—Alfalfa (continuously cropped).
No. 9.—Flax (continuously cropped), fall plowed.
No. 16.—Two years:
Oats on disked corn ground.
Corn, fall plowed.
No. 18.—Two years:
Wheat on disked beet ground.
Beets, fall plowed.
No. 20.—Two years:
Potatoes, fall plowed.
Beets, fall plowed.
No. 21.—Two years:
Potatoes, fall plowed.
Beets, (manured) fall plowed.
No. 22.—Two years:
Oats on disked beet ground.
Beets, fall plowed.

No. 23.—Two years:
Oats (manured), on disked beet ground.
Beets, fall plowed.

No. 24.—Two years:
Oats on disked potato ground.
Potatoes, fall plowed.

No. 25.—Two years:
Oats (manured) on disked potato ground.
Potatoes, fall plowed.

No. 26.—Two years:
Potatoes, fall plowed.
Corn, fall plowed.

No. 27.—Two years:
Oats on disked potato ground (rye seeded in oat stubble in fall).
Potatoes, spring plowed.

No. 28.—Two years:
Wheat, fall plowed.
Oats, fall plowed.

No. 30.—Three years:
Potatoes, fall plowed.
Oats on disked potato ground.
Beets, fall plowed.

No. 31.—Three years:
Potatoes, fall plowed.
Oats (manured) on disked potato ground.
Beets, fall plowed.

No. 32.—Three years:
Corn, fall plowed.
Oats, on disked corn ground.
Beets, fall plowed.

No. 40.—Four years:
Potatoes, crowned, fall plowed.
Beets, fall plowed.

No. 40.—Four years—Contd.
Alfalfa on disked beet ground.
Alfalfa.

No. 42.—Four years:
Oats, crowned, fall plowed.
Beets, fall plowed.
Alfalfa on disked beet ground.
Alfalfa.

No. 44.—Four years:
Potatoes, crowned, fall plowed.
Oats on disked potato ground.
Alfalfa, seeded in oat stubble in fall.
Alfalfa.

No. 60.—Six years:
Potatoes, crowned, fall plowed.
Oats, on disked potato ground.
Beets, fall plowed.
Alfalfa on disked beet ground.
Alfalfa.
Alfalfa.

No. 61.—Six years:
Potatoes, crowned, fall plowed.
Oats (manured) on disked potato ground.
Beets, fall plowed.
Alfalfa on disked beet ground.
Alfalfa.
Alfalfa.

No. 67.—Six years:
Corn, hogged off, crowned, fall plowed.
Flax on disked corn ground.
Beets, fall plowed.
Alfalfa on disked beet ground.
Alfalfa.
Alfalfa, pastured with hogs.

ROTATIONS BEGUN IN 1916, FIELD L–IV.

No. 1a.—Oats (continuously cropped), fall plowed.

No. 2a.—Beets (continuously cropped), fall plowed.

No. 4a.—Potatoes (continuously cropped) fall plowed.

No. 6a.—Corn (continuously cropped), fall plowed.

No. 8a.—Alfalfa (continuously cropped).

No. 34.—Three years:
Potatoes, fall plowed.
Beets, fall plowed.
Oats on disked beet ground.

No. 35.—Three years:
Potatoes, fall plowed.
Beets, fall plowed.
Oats (manured) on disked beet ground.

No. 46.—Four years:
Alfalfa, seeded in oat stubble in fall.
Alfalfa.
Beets, crowned, fall plowed.
Oats on disked beet ground.

No. 64.—Six years:
Alfalfa (1) seeded in oat stubble in fall.
Alfalfa (2).
Alfalfa (3).
Potatoes, crowned, fall plowed.
Beets, fall plowed.
Oats on disked beet ground.

No. 69.—Six years:
Alfalfa (1), seeded in oat stubble in fall.
Alfalfa (2).
Alfalfa (3), pastured with hogs.
Corn, hogged off, crowned, fall plowed.
Corn, hogged off, fall plowed.
Oats on disked corn ground.

CROP YIELDS.

With the season of 1918 the rotation experiment completes its seventh year on the old rotations and its third year on the new ones. It is still too early to draw definite conclusions, but, nevertheless, it is possible to see by a comparison of the results obtained in 1918 with those of previous years some indications which may be useful to those engaged in crop production under conditions similar to those where this experiment has been conducted. A summary of the yields secured in these experiments since 1913 is given in Table IV.

TABLE IV.— *Yields of crops in the irrigated rotations on the Huntley Experiment Farm during the 6-year period from 1913 to 1918, inclusive.*

Crop.	Variety.	Number of plats.	Unit of yield.	Yield per acre.							
				1918			Average yield.				
				Maximum.	Minimum.	Average.	1917	1916	1915	1914	1913
Alfalfa:											
Spring seeded	Montana	5	Ton	2.43	2.02	2.22	2.03	2.07	2.34	2.22	2.20
Fall seeded	do	4	do	3.49	2.49	3.17	3.42	.....	.....	.....	.....
Second year	do	9	do	6.45	4.40	5.34	5.71	5.26	7.14	5.40	5.85
Third year	do	6	do	6.64	5.06	6.13	5.38	6.26	7.00	5.26	5.35
Continuously cropped.	do	4	do	6.09	4.87	5.45	4.65	4.98	4.72	4.62	4.51
Sugar beets	Kleinwanzlebener.	19	do	16.53	7.15	12.22	9.82	11.53	9.58	11.16	13.08
Potatoes	Mills Prize	17	Bushel	519.30	87.80	367.60	218.20	228.70	301.80	167.80	212.70
Oats	Swedish Select	21	do	127.00	44.50	90.70	75.00	71.10	79.30	89.80	84.20
Wheat	Pringle Champion.	5	do	35.40	16.10	23.90	26.50	26.50	32.30	32.70	27.20
Corn	Northwestern Dent.	5	do	52.20	34.80	45.90	32.60	36.30	36.90	42.90	42.00
Flax	Minnesota No. 25	2	do	31.80	8.60	20.20	18.90	17.70	21.30	18.60	21.70

Table IV shows a wide difference between the highest and lowest yields obtained from the different plats. In most cases the maximum yield was more than twice the minimum. The relation that exists between these differences in crop yields and the effect of the preceding crop is shown in Table V.

TABLE V.—*Preceding crop, average yield per acre, and number of plats of each crop in the rotation experiments on the Huntley Experiment Farm in 1918.*

Preceding crop.	Beets.		Potatoes.		Oats.		Corn.		Wheat.		Flax.	
	Number of plats.	Yield.	Number of plats.	Yield.	Number of plats.	Yield.	Number of plats.	Yield.	Number of plats.	Yield.	Number of plats.	Yield.
		Tons.		*Bushels.*		*Bushels.*		*Bushels.*		*Bushels.*		*Bushels.*
Alfalfa	1	9.40	5	416.5	1	103.2	.....	.....	.....	.....	.....	.....
Beets	2	11.75	3	333.7	6	101.9	1	45.6	1	35.4	.....	.....
Beets (manured)	.....	.....	1	319.5	.....	.....	.....	.....	.....	.....	.....	.....
Potatoes	6	13.91	2	201.3	8	95.9	1	48.3	.....	.....	.....	.....
Oats	5	11.11	2	370.2	2	63.7	1	50.2	1	16.1	.....	.....
Oats (manured)	3	12.23	2	483.6	.....	.....	.....	.....	.....	.....	.....	.....
Oats (rye)	.....	.....	1	159.6	.....	.....	.....	.....	.....	.....	.....	.....
Corn	.....	.....	1	303.6	2	72.5	2	42.6	.....	.....	.....	.....
Corn (hogged)	.....	.....	.....	.....	1	100.2	1	[a]54.0	.....	.....	1	31.8
Wheat	1	7.15	.....	.....	1	49.5	.....	.....	2	21.9	.....	.....
Wheat (straw returned)	.....	.....	.....	.....	.....	.....	.....	.....	1	24.3	.....	.....
Alfalfa (hogged)	.....	.....	.....	.....	.....	.....	2	[a]60.5	.....	.....	.....	.....
Flax	1	16.53	.....	.....	.....	.....	.....	.....	.....	.....	1	8.6
Total number of plats	19	.....	17	.....	21	.....	8	.....	5	.....	2	.....
Average yield	.....	12.23	.....	367.6	.....	90.7	.....	50.9	.....	23.9	.....	20.2

[a] Yields estimated.

TABLE VI.— *Yields per acre of oats, potatoes, and sugar beets, with preceding crops in all rotations, on the Huntley Experiment Farm in 1918.*

Oats.			Potatoes.			Sugar beets.		
Preceding crop.	Rotation No.	Yield.	Preceding crop.	Rotation No.	Yield.	Preceding crop.	Rotation No.	Yield.
		Bushels.			*Bushels.*			*Tons.*
Potatoes	60	127.0	Oats (manured)	25	519.3	Flax	67	16.53
Do	61	118.8	Alfalfa	61	473.7	Potatoes	40	16.18
Beets	34	113.0	Oats (manured)	35	448.0	Oats (manured)	61	14.68
Do	35	110.8	Alfalfa	40	445.3	Potatoes	20	14.59
Do	64	106.3	....do	64	445.0	Beets	2a	14.58
Alfalfa	42	103.2	Potatoes	4a	443.3	Oats	60	14.22
Beets	46	103.0	Oats	34	425.3	Potatoes	21	13.69
Corn (hogged)	69	100.2	Beets	20	390.3	....do	34	13.54
Beets	22	98.8	Alfalfa	44	373.3	....do	35	13.24
Potatoes	24	93.3	....do	60	345.3	Oats	42	13.14
Do	44	93.0	Beets	31	324.5	Potatoes	64	12.24
Do	25	92.5	Beets (manured)	21	319.5	Oats (manured)	23	11.38
Do	31	86.5	Oats	24	315.2	....do	31	10.64
Oats	1a	82.0	Corn	26	303.6	Oats	22	10.20
Corn	16	81.3	Beets	30	286.4	....do	32	9.55
Potatoes	30	80.1	Potatoes	4	232.0	Alfalfa	46	9.40
Beets	23	79.6	Oats—rye	27	159.6	Beets	2	8.92
Potatoes	27	76.1				Oats	30	8.44
Corn	32	63.7				Wheat	18	7.15
Wheat	28	49.5						
Oats	1	45.5						
Average of all plats	.....	90.7	.....	.....	367.6	.....	.....	12.23

Table VI shows the yields of oats, potatoes, and beets for each rotation in 1918, with the immediately preceding crop in each case. The yields are arranged in order from the highest to the lowest, so that an inspection of this table will readily show which preceding crop or treatment gave the best results in 1918. It should be kept

in mind, however, that all plats are not on equally good soil and also that these results are for one season only.

Summarizing the results obtained from these rotation experiments for the years 1912 to 1918, inclusive, the following comments may be made on each crop grown.

Alfalfa seeded in the fall in the oat stubble produces more tons of hay per acre than when seeded the following spring. In some years the maximum production of alfalfa is reached the second year; in others, the third year.

Sugar beets grown in a rotation in which one of the crops is manured or when following a cultivated crop make the greatest yields. When grown after a grain crop without manure the beets are usually small and the tonnage low.

Potatoes make the greatest yields when grown in a rotation which includes alfalfa or a manured crop.

The highest yields of oats are obtained in rotations including alfalfa or a manured crop. Oats following any cultivated crop yield much better than when following a grain crop. Oats after oats or wheat is an undesirable sequence, as the crop becomes infested with wild oats and a very low yield usually results.

The best average yield of wheat has been obtained in a 2-year rotation with sugar beets. Wheat grown on the same plat each year for the last seven years yielded an average of 29.5 bushels. On an adjoining plat, also seeded to the same variety of wheat for seven years but having the straw returned each fall and plowed under, the average yield was 29.9 bushels per acre.

Three of the eight plats of corn grown in these rotations are harvested by hogs and the results are reported under "Hogging-off corn." The highest yields of corn are obtained in rotations in which the corn follows alfalfa or a cultivated crop.

The advantage of growing flax in a rotation, as compared with continuous cropping, has been clearly demonstrated from year to year. The average yield of the former for the past six years has been more than double the latter.

SILAGE CROPS.

SUNFLOWERS.

Tests of sunflowers made in recent years appeared to indicate that this crop would be valuable to grow under certain conditions for silage. Yields secured at Huntley and at other field stations were much higher than the yields of corn grown under similar conditions. Since this crop was comparatively new, little information was at hand as to the proper cultural methods.

An experiment was conducted in field A–V in which sunflowers were grown in rows 20, 30, and 40 inches apart. (Fig. 2.) In each width of row the plants were thinned, respectively, to 3, 6, and 12 inches apart. In all cases the seed was drilled thickly in the rows and the plants were thinned to the desired distance. The variety of sunflowers grown was Mammoth Black Russian. Seeding was done on May 21 with a corn planter. A corn cultivator was used for the three cultivations given during the season. Irrigation was applied uniformly on July 9, August 2, and August 18. The crop was harvested for silage on September 30. The height of the plants at harvest time averaged 11 to 12 feet, and there was but little variation from this on any of the plats, regardless of the planting or

FIG. 2.—Sunflowers for silage growing on field A-V on the Huntley Experiment Farm in 1918.

spacing distance. On about one-half of the plants the seed heads were formed, and some were so far advanced that the seeds were in the hard dough stage. The remainder of the plants were in various stages of blooming. The crop was so heavy that it was not possible to use a corn binder in harvesting, and it was necessary to harvest by hand with corn knives. The yields obtained are given in detail in Table VII.

Table VII indicates that the highest yield, which was at the rate of 37.62 tons per acre, was obtained from the 20-inch rows in which the plants were 3 inches apart in the row. The lowest yield, 24.52 tons per acre, was obtained on the plat on which the rows were 40 inches apart and the plants thinned to 12 inches apart in the row. The average yield for the entire field of 2.14 acres was

at the rate of 31.4 tons per acre. Considering the average yields from the plats with different widths of rows regardless of the thinning distance, the highest yields are noted in the 20-inch rows and the lowest in the 40-inch rows.

TABLE VII.— *Yields of sunflowers for silage on the Huntley Experiment Farm in 1918.*

Plat.	Area (acres).	Width of row.	Thinned.	Yield.	
				Per plat.	Per acre.
		Inches.	*Inches.*	*Pounds.*	*Tons.*
No. A-V-1	0.265	20	12	19,178	36.20
No. A-V-2	.258	20	6	17,219	33.38
No. A-V-3	.251	20	3	18,910	37.62
No. A-V-4	.229	30	12	14,565	31.80
No. A-V-5	.223	30	6	14,138	31.70
No. A-V-6	.261	30	3	17,105	32.85
No. A-V-7	.225	40	12	12,825	28.46
No. A-V-8	.109	40	6	6,765	31.02
No. A-V-9	.108	40	3	5,765	26.68
No. A-V-10	.212	40	12	10,400	24.52
Average of 3 plats		20			35.73
Do		30			32.12
Average of 4 plats		40			27.67
Average of 3 plats			3		33.83
Do			6		30.59
Average of 4 plats			12		30.24

Considering the average yields on the plats with different thinning distances, the highest are found on those on which the plants were 3 inches apart in the row and lowest on the plats on which the plants were 12 inches apart. Apparently the best quality of silage was made from the plants grown in the 20-inch rows that were thinned to 3 inches apart in the row. The plants here were smaller and less woody when cut up for silage than was the case with wider planting and thinning, and the results would indicate that close planting is desirable both from the standpoint of yield and quality of silage. Apparently all of the sunflowers were allowed to become too far matured before harvesting to make the most palatable silage, since much of it remained hard and woody after being placed in the silo and was not very readily eaten by cows.

CORN.

Corn for silage, Northwestern Dent variety, was grown on fields B–II and B–III, which contain 7.81 acres. From previous tests of early-maturing varieties of corn at the experiment farm, this variety appeared to give the highest yields. The crop was harvested on September 20, at which time the corn was fairly well dented and considered to be at about the proper stage of maturity to make the best quality of silage. The yield was at the rate of 9.32 tons per acre.

CORN VARIETY TEST.

A test of three varieties of corn was conducted on 20 one-fourth acre plats in field O. This field was broken up from native sod in 1917. The varieties grown in this test were Northwestern Dent, Local Yellow Dent, and Minnesota No. 13. These varieties were selected as being the ones most commonly grown on the project, and the seed of each was grown locally. All the varieties were fully matured before frost occurred. The Northwestern Dent was matured by September 20 and the other two varieties by September 25. A statement of the yields secured in this test are given in Table VIII.

TABLE VIII.— *Yields of corn varieties on the Huntley Experiment Farm in 1918.*

Variety.	Yield.			
	Per plat.		Per acre.	
	Stover.	Corn.	Corn.	Total, corn and stover.
	Pounds.	*Pounds.*	*Bushels.*	*Pounds.*
Northwestern Dent	1,374	1,235	66.8	10,439
Local Yellow Dent	1,164	909	50.0	8,237
Minnesota No. 13	1,029	871	48.4	7,602

The yields given in Table VIII are the average of six plats of Northwestern Dent and the average of seven plats each of Minnesota No. 13 and Local Yellow Dent. The Northwestern Dent was the highest yielding variety, both in weight of grain and in total yield, and it also matured earlier than either of the other varieties.

CLOVER SEED PRODUCTION.

A test of seed production with alsike clover, white clover, and red clover was conducted on 24 quarter-acre plats in fields L–I and L–II. The plan of the test provided that on four plats of each variety of clover the first crop was to be harvested for hay and the second crop left to make seed (method No. 1) and on the remaining four plats of each variety the first crop was to be left for seed (method No. 2). These clovers were seeded in 1916 in a method-of-seeding experiment and were used in 1917 in a seed-production test. In the method-of-seeding experiment in 1916 four of the plats of each variety were seeded with a nurse crop of wheat, two plats of each were seeded in the spring without a nurse crop, and two plats were seeded in late summer in wheat stubble. In all cases good stands were secured, although the growth was much better and less weedy in 1917 on the plats that were seeded without a nurse crop. Weeds were especially troublesome on the late summer-seeded plats. This condition was less

noticeable in 1918 in the case of the alsike clover and red clover, while it still persisted on the white clover plats, and with this variety it was only on the plats that were seeded without a nurse crop that any seed was produced. The yields obtained in this test are shown in Table IX.

TABLE IX.— *Yields of hay and seed in the seed-production test with alsike clover, white clover, and red clover on the Huntley Experiment Farm in 1918.*

Variety of clover.	Number of plats.	Method used.	Yield per acre.	
			Hay.	Seed.
			Tons.	*Bushels.*
Alsike	4	No. 1	0.66	1.9
Do	4	No. 2		6.0
White	4	No. 1	.46	
Do	2	No. 2		2.8
Red	4	No. 1	1.94	1.0
Do	4	No. 2		3.8

The results given in Table IX indicate that profitable yields of seed were obtained only on the plats on which the first crop was left for seed (method No. 2). In the case of the white clover no seed was produced on the plats on which the first crop was cut for hay, and only on the plats that were spring seeded without a nurse crop was any seed produced.

SUGAR-BEET ROOT-LOUSE CONTROL.

The experiment in methods of control of damage by invasions of the sugar-beet root louse which has been conducted each year since 1914 in cooperation with the biology department of the Montana Agricultural Experiment Station was continued in 1918 on 16 tenth-acre plats in field L–II. This same field was used for the experiment in 1916 and 1917.

The outlines of the experiment provided for applying varying numbers of irrigations (from two to five) during the season for the purpose of determining whether a larger quantity of irrigation water than is applied in ordinary practice would be effective in checking the damage done by the root louse.

The root lice are hatched on trees of the narrow-leaf cottonwood which grow on the river bottoms, and the insects migrate in large numbers to the beet fields during the later part of June or early in July. Once they become established in the soil around the beets they soon increase in numbers to such an extent as to damage the beet crop seriously. In ordinary practice sugar beets are not irrigated until the later part of July, or until after the insects have invaded the fields. It has been thought that by applying irrigation at about the time of the migration and keeping the soil thoroughly moist it might be possible to lessen the damage to the beets. The dates of irrigation in this experiment were as follows: Five irrigations—July 5, 15, and

25 and August 12 and 25; four irrigations—July 10 and 20 and August 5 and 19; three irrigations—July 18 and August 5 and 19; and two irrigations—July 25 and August 20. The plats that were irrigated three times were watered at about the time that beets are irrigated in ordinary farm practice. The yields and other data relating to this test are shown in Table X. The yields in each case are the average of four plats.

TABLE X.— *Yields of beets in the sugar-beet root-louse control experiment on the Huntley Experiment Farm in 1918.*

Number of irrigations.	Yield per acre.	Sugar content of beets (per cent).			Beets injuriously infested
		Not infested.	Infested.	Average sample	
	Tons.				*Per cent.*
2	14.14	16.5	16.5	15.9	1.21
3	14.18	17.3	16.8	16.4	1.08
4	14.09	18.6	18.5	15.5	.30
5	13.78	17.1	16.9	15.3	.21

Table X indicates that the amount of infestation on any of the plats, regardless of the number of irrigations, was very small and perhaps not sufficient in any case to affect the yield. This was the case also in other fields that were observed and was due apparently to general climatic conditions that at some time during the season were unfavorable for the development of the root louse.

BARLEY VARIETY TEST.

A test of five varieties of barley was conducted in duplicate on 11 quarter-acre plats in field O–I. This field was broken up from native sod in 1917. The seeding rate of 2 bushels per acre was uniform for all plats. Two irrigations were applied, on June 18 and July 14. The yields are given in Table XI.

TABLE XI.— *Yields of barley in the variety test on the Huntley Experiment Farm in 1918.*

Variety.	Date of maturity.	Yield per acre.
		Per cent.
Trebi	July 16	70.5
White Smyrna	do	62.0
Chevalier	July 23	61.5
Hannchen	do	53.9
Svanhals	do	50.9

In this test the Trebi variety gave the highest yield. (Fig. 3.) Excellent yields of this variety were also obtained in a larger field in 1918, and it appears to be well suited to irrigated conditions in

this region. Trebi barley was also grown in field A–IV on 14 quarter-acre plats as a nurse crop with alfalfa. The average yield on these plats was at the rate of 94.7 bushels per acre.

FRUIT TREES.

A test of about 100 varieties of apples, plums, and cherries was begun on the experiment farm in 1911. Many of these trees have been lost each year by winterkilling and a large number of the apple varieties have been replaced by trees of varieties that appeared to be more hardy. None of the varieties of cherries proved to be hardy. None of the apple trees have yet borne fruit and the growth of the trees is very slow. Some fruit has been produced during the past three seasons on the crab apple and plum trees. The varieties of apples that were affected least by winter injury were the North-

FIG. 3.—Trebi barley in field A–IV on the Huntley Experiment Farm in 1918. The yield of this field was at the rate of 94 bushels per acre.

western Greening, Pattens Greening, Wealthy, and Hibernal. The varieties of crab apples that have produced fruit are the Florence and Minnesota.

CROP-UTILIZATION EXPERIMENTS.

PASTURING ALFALFA WITH HOGS.

The pasturing tests in connection with the rotation experiments are conducted on two quarter-acre plats, one in rotation No. 67, field K, and the other in rotation No. 69, field L–IV. The pasturing season is divided into two periods: April to July, the spring period, and July to October, the summer period. Fall pigs are used during the first period and spring pigs during the second. In each case, pigs are put on at the rate of 1,500 to 2,000 pounds per acre.

Each plat is divided into two equal areas and the hogs are pastured alternately on each area for a period of 9 to 12 days, depending upon weather conditions and the growth of the alfalfa. This arrange-

ment allows a more uniform growth of pasture and is a convenience in irrigating. The hogs are weighed at the end of each 14-day period, and the results are reported on an acre basis. In addition to the pasture, the hogs are fed a supplementary ration of shelled corn at the rate of 2 pounds daily per 100 pounds of live weight.

The results obtained from the alfalfa-pasturing experiment for the years 1913 to 1918, inclusive, are shown in Table XII.

TABLE XII.—*Results, calculated to an acre basis, of the alfalfa-pasturing experiments on the Huntley Experiment Farm during the 6-year period from 1913 to 1918, inclusive.*

Year.	Rotation No.	Number of hogs.		Number of days.	Weight (pounds).				
		Spring.	Summer.		Initial.	Final.	Gain.		Grain per pound of gain.
							Total.	Average daily per hog.	
1913 [a]	67	.....	48	41	2,788	3,624	836	0.50	2.65
1914	67	16	36	138	3,272	5,572	2,300	.42	2.78
1915	67	20	32	150	4,364	6,840	2,476	.70	3.13
1916	67	20	32	145	3,520	6,552	3,032	.85	2.79
1917	67	16	36	150	3,280	5,460	2,180	.74	2.87
1917	69	20	32	152	3,288	5,768	2,480	.72	2.64
1918	67	20	32	148	3,200	5,560	2,360	.66	2.72
1918	69	20	32	148	3,216	5,464	2,248	.63	2.85
Average	.....	19	33	147	3,449	5,888	2,439	.67	2.83

[a] As only the third crop of alfalfa was pastured in 1913, these results are not used in determining the averages.

HOGGING-OFF CORN.

The spring pigs used in the alfalfa pasturing experiment in rotation No. 67 are used to hog-off the corn in the same rotation in the fall. (Fig. 4.) These hogs are put on the plats of matured corn at the rate of 1,000 to 1,500 pounds per acre.

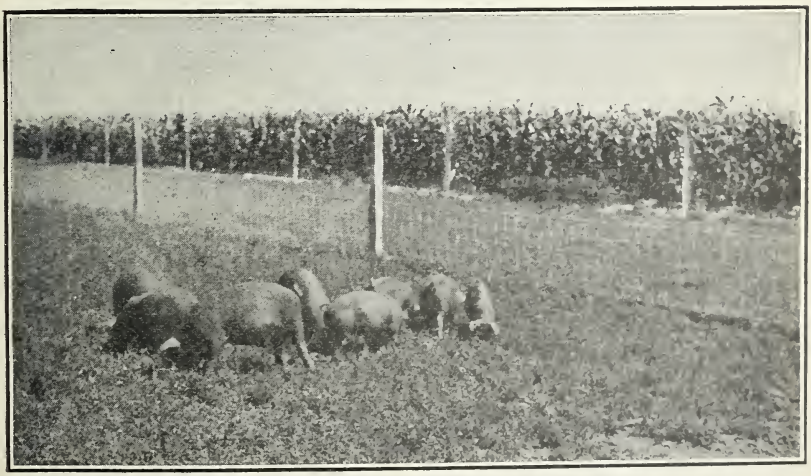

FIG. 4.—Hogs on alfalfa pasture in rotation No. 67 on the Huntley Experiment Farm in 1918.

Table XIII presents the results obtained from the corn for the years 1912 to 1918, inclusive, reported on an acre basis.

TABLE XIII.—*Results, calculated to an acre basis, of hogging-off corn on the Huntley Experiment Farm during the 7-year period from 1912 to 1918, inclusive.*

Year.	Number of hogs.	Number of days.	Weight (pounds).					Estimated yield (bushels).
			Initial.	Final.	Total gain.	Pork, per acre, per day.	Grain per pound of gain.	
1912	20	16	2,900	3,288	388	24.2	5.3	36.4
1913	16	23	1,312	2,280	768	33.3	4.4	60.0
1914	16	22	1,380	2,276	896	40.7	3.2	50.4
1915	16	25	1,376	2,240	864	32.6	4.5	52.4
1916	16	20	1,516	2,188	672	33.6	5.0	60.0
1917	16	24	1,200	1,828	628	25.2	3.8	43.2
1918	16	27	1,428	2,152	724	26.8	5.1	65.0
Average	17	22	1,587	2,293	706	30.9	4.5	52.5

HOGGING-OFF CORN AND RAPE.

In rotation No. 69, Dwarf Essex rape at the rate of 8 pounds per acre is drilled between the corn rows about the last of July. By the time the corn is mature in the fall and the rape has made a good growth, the hogs are taken off the alfalfa pasture in the same rotation and put on the corn plats.

TABLE XIV.—*Results, calculated to an acre basis, of hogging-off corn and rape on the Huntley Experiment Farm in 1916, 1917, and 1918.*

Year.	Number of hogs.	Number of days.	Weight (pounds).					Estimated yield (bushels).
			Initial.	Final.	Total gain.	Pork, per acre, per day.	Grain per pound of gain.	
1916	8	38	660	1,246	586	15.42	4.85	50.8
1917	16	22	1,168	1,700	532	24.18	4.33	41.1
1918	16	35	1,156	1,964	808	23.10	3.80	55.0
Average	13	32	995	1,637	642	20.90	4.33	49.0

TABLE XV.—*Comparison of results, calculated to an acre basis, of hogging-off corn for three years with rape and for seven years without rape on the Huntley Experiment Farm.*

Items of comparison.	Average results.	
	Seven years, without rape.	Three years, with rape.
Number of hogs per acre	17	13
Duration of test.....days..	22	32
Total weight:		
Initial.....pounds..	1,587	995
Final.....do....	2,293	1,637
Gain.....do....	706	642
Pork per acre per day.....do....	30.9	20.90
Estimated yield of corn.....bushels..	52.5	49.0
Estimated grain fed per pound of gain.....pounds..	4.5	4.33

The results obtained from hogging-off corn and rape for the years 1916, 1917, and 1918 are given in Table XIV.

Comparing the average results for seven years of hogging-off corn without rape with the average of three years of hogging-off corn and rape, there seems to be no increase in gain in favor of the rape. This comparison is shown in Table XV.

FEEDING EXPERIMENTS.

EXPERIMENTS WITH HOGS.

Experiments with hogs were begun in 1917 in cooperation with the Bureau of Animal Industry, of the United States Department of Agriculture, and the Montana Agricultural Experiment Station.[1] The experiments conducted in 1918 were practically a continuation of those started in 1917, with a few minor changes and additions, and they included a comparison of varying grain rations as a supplement to alfalfa pasture for hogs, a comparison of different grain feeds for finishing hogs fed in a dry lot, pasturing brood sows on alfalfa pasture with a grain ration and without a grain ration, a comparison of Turkestan and common alfalfa as pasture for spring pigs, and a test of hogging-off corn with spring pigs.

The hogs used in these experiments were of the Duroc-Jersey breed, and all except a few were pure bred.

In the alfalfa-pasturing work, the pasture lots used were one-fourth of an acre in size except in the case of the lot on pasture without grain, where the area of the pasture lot was half an acre. In all cases except one the pastures were divided and pastured alternately in periods of 10 days to 2 weeks each. Each part of the pasture was irrigated as soon as the hogs were removed, and good growth had been made before the hogs were returned to it.

SPRING PIGS ON ALFALFA PASTURE WITH VARYING GRAIN RATIONS.

Six lots of spring pigs were placed on pasture on July 9 and remained until September 18, a period of 71 days. Lot 1 received no grain, lot 2 was fed a 1 per cent ration of corn,[2] lots 3 and 4 were fed a 2 per cent ration of corn, lot 5 was fed a 3 per cent ration of corn, and lot 6 was fed a full ration of corn in a self-feeder.

The results of this experiment are given in Table XVI. This table shows that very small gains were made by the hogs that received no grain and also by the hogs that were fed a 1 per cent ration of corn. Both of these lots were in a very unthrifty condition at the close of the experiment. Lot 3, which was fed a 2 per cent ration of corn and divided pasture, made slightly more economical gains

[1] These experiments were from the beginning until September 1 under the immediate supervision of Mr. C. V. Singleton, who was detailed by the Bureau of Animal Industry for this work. From September 1 to the end of the season Mr. A. E. Seamans, of the Office of Dry-Land Agriculture, had charge of the work.

[2] This was 1 per cent of grain daily for each 100 pounds of live weight of hogs.

than lot 4, which received the same grain rations but was on undivided pasture. The divided pasture made better growth and furnished more grazing than the undivided one. Lot 6, which was given all the corn that the pigs would eat from a self-feeder, made exceptionally good gains and required only 2.48 pounds of grain per pound of gain, which was less than any of the other lots except lot 2.

TABLE XVI.—*Results of feeding spring pigs on varying grain rations as a supplement to alfalfa pasture on the Huntley Experiment Farm in 1918.*

Items of comparison.	Lot 1, no grain.	Lot 2, 1 per cent corn.	Lot 3, 2 per cent corn.	Lot 4, 2 per cent corn.	Lot 5, 3 per cent corn.	Lot 6, full feed corn.
Area of pasture.....acres..	0.50	0.25	0.25	0.25	0.25	0.25
Number of pigs in lot.....	9	7	8	8	9	9
Average weight:						
Initial.....pounds..	38	37	38	37	39	38
Final.....do....	46	51	65	63	83	115
Daily gain.....do....	.11	.20	.38	.37	.62	1.08
Gain per acre.....do....	144	400	864	832	1,592	2,760
Grain fed per pound of gain.....do....	.....	2.32	2.80	2.90	2.94	2.48

BROOD SOWS ON ALFALFA PASTURE.

Three lots of five yearling and 2-year-old brood sows each were placed on alfalfa pasture on July 2. Each pasture was one-fourth of an acre in size and divided into two parts. Lot 1 received no grain, lot 2 was fed a ration of 1 per cent corn, and lot 3 a ration of 1 per cent corn and tankage as a supplement to the alfalfa pasture. The tankage and corn were fed in the proportion of 1 to 6. The pasture period extended to September 3. On August 20 two sows were removed from each lot, as the growth of the pasture was not sufficient to support the original five head per plat. The results of these tests are given in Table XVII.

TABLE XVII.—*Results of tests with brood sows on alfalfa pasture alone and supplemented with grain and tankage on the Huntley Experiment Farm in 1918.*

Items of comparison.	Lot 1, no grain.	Lot 2, 1 per cent corn.	Lot 3, 1 per cent corn and tankage.
Number of sows.....	5	5	5
Duration of test.....days..	63	63	63
Average weight of sows:			
Initial.....pounds..	293	296	298
Final.....do....	277	329	332
Daily gain.....do....	— .41	.52	.54
Grain fed per pound of gain.....do....	.....	4.85	4.71

Lot 1, which received no grain, lost an average of 26 pounds per head during the 63 days, while lots 2 and 3 made an average gain per head of 33 and 34 pounds, respectively, for the period. The number of pounds of grain required per pound of gain was slightly less for lot 3 than for lot 2.

COMPARISON OF TURKESTAN AND COMMON ALFALFA AS HOG PASTURE.

Preliminary tests in grazing Turkestan alfalfa in 1917 indicated that hogs preferred this to common alfalfa and warranted outlining an experiment in which the value of Turkestan and common alfalfa could be directly compared. Two lots of eight spring pigs each were used in this experiment. Lot 1 was placed on a quarter-acre plat of Turkestan alfalfa and lot 2 on a similar-sized plat of common alfalfa. Each plat was divided into two equal parts and pastured alternately, each lot receiving a 2 per cent ration of corn. The pasturing period extended from July 9 to September 18. The common alfalfa produced a better growth during the period than the Turkestan, and although the hogs show a preference for the latter when both kinds are available, this fact does not appear to be of sufficient importance to warrant the growing of Turkestan alfalfa in preference to the common for hog pasture. The results of the test are presented in Table XVIII.

TABLE XVIII.—*Results of pasturing common and Turkestan alfalfa with hogs on the Huntley Experiment Farm in 1918.*

Item of comparison.	Lot 1, Turkestan alfalfa.	Lot 2, common alfalfa.
Number of pigs in the lot	8	8
Average weight:		
Initial....pounds..	37	38
Final....do....	60	65
Daily gain....do....	.32	.38
Gain per acre....do....	732	864
Grain fed per pound of gain....do....	3.31	2.80

HOGGING-OFF CORN SUPPLEMENTED WITH ALFALFA.

Two lots of six hogs each were used in a test of hogging-off corn. On October 8 each lot was placed on a plat of corn containing three-fourths of an acre. Lot 1 was not given any supplementary feed, while lot 2 had access to all the alfalfa hay the hogs would consume. The plat harvested by lot 2 contained more corn than the one harvested by lot 1, necessitating a longer pasture period for lot 2. The results of the experiment are presented in Table XIX.

TABLE XIX.—*Results of hogging-off corn on the Huntley Experiment Farm in 1918.*

Items of comparison.	Lot 1, corn alone.	Lot 2, corn and alfalfa hay.
Area of pasture....acres..	0.75	0.75
Number of hogs	6	6
Duration of test....days..	41	60
Total weight:		
Initial....pounds..	427	424
Final....do....	719	979
Average daily gain....do....	1.19	1.54
Yield per acre (estimated)....bushels..	46.1	67.7
Hay consumed....pounds..	.....	100
Grain fed per pound of gain....do....	6.64	5.13

The results indicate that the hogs that were fed alfalfa hay in addition to the corn made much better and more economical gains, requiring about 1½ pounds less of corn per pound of gain than the hogs that were not fed hay.

DRY-LOT FINISHING OF FALL PIGS.

A test of the comparative value of alfalfa, tankage, and skim milk as supplements to corn for finishing hogs in a dry lot was conducted with four lots of fall pigs. Lot 1 was fed corn alone in a self-feeder; lot 2 was fed corn and alfalfa hay; lot 3 was fed corn and tankage, both being fed in a self-feeder; and lot 4 was fed corn in a self-feeder, and in addition received 125 to 150 pounds of skim milk per day. Ten hogs were used in each of lots 1, 2, and 4, and 11 hogs in lot 3. The feeding period extended from July 27 to August 12, 16 days.

Table XX gives the data relating to the test. The results indicate that the rate of gain was greatest for the lot that received skim milk, and that less grain per pound of gain was required by this lot. Lot 3, which received tankage in addition to corn, required 3.32 pounds of grain per pound of gain; lot 2, which was given alfalfa hay in addition to corn, required 3.80 pounds of corn per pound of gain; and lot 1, on corn alone, required 4.01 pounds of grain per pound of gain.

TABLE XX.—*Results of finishing fall pigs in a dry lot after the spring pasture season on the Huntley Experiment Farm in 1918.*

Items of comparison.	Lot 1, corn alone.	Lot 2, corn and alfalfa hay.	Lot 3, corn and tankage.	Lot 4, corn and skim milk.
Number of hogs	10	10	11	10
Average weight:				
Initial....pounds	172	173	172	171
Final....do	207	212	216	223
Daily gain....do	2.19	2.44	2.75	3.25
Grain fed per pound of gain....do	4.01	3.88	3.32	2.80
Tankage fed....do	.....	.....	169	.....
Alfalfa fed....do	.....	30	.....	.....
Skim milk fed....do	.....	.....	.....	2,341

DRY-LOT FINISHING OF SPRING PIGS.

At the close of the summer pasturing period, on September 18, five of the six lots of spring pigs that had been used in the alfalfa-pasturing test with varying grain rations were placed in dry lots to be finished and were all given a full feed of corn from a self-feeder, supplemented by all of the alfalfa hay that they would consume. Each lot was kept on feed until the hogs were in finished condition and weighed from 170 to 210 pounds in the various lots.

The results obtained in this experiment are shown in Table XXI. The quantity of grain consumed by each lot was comparatively large in proportion to the gains made, owing largely to the poor quality of corn available for feeding. Lot 5, which had received a ration of 3 per cent of corn while on alfalfa pasture, made the most economical

gains. This lot required 4.70 pounds of corn per pound of gain. Lot 1, which had been on alfalfa pasture without grain, and lot 2, which had been on alfalfa pasture and a 1 per cent ration of corn, both required 184 days to reach a finished condition for market and were then still rather ununiform. Lots 5 and 6 were ready for market at the end of a period of 114 days, at which time they were in good uniform thrifty condition.

TABLE XXI.—*Results of finishing pigs in a dry lot after the summer pasture season on the Huntley Experiment Farm in 1918.*

Items of comparison.	Lot 1.	Lot 2.	Lot 3.	Lot 5.	Lot 6.
Number of pigs	9	7	8	9	9
Dry-lot period.....days..	184	184	150	114	114
Initial weight:					
Of lot.....pounds..	417	359	517	748	1,036
Per pig.....do....	46	51	65	83	115
Final weight:					
Of lot.....do....	1,532	1,204	1,571	1,887	1,852
Per pig.....do....	170	172	196	210	206
Gain:					
Of lot.....do....	1,115	845	1,054	1,139	816
Per pig.....do....	124	121	132	127	91
Per pig per day.....do....	0.70	0.71	0.94	1.11	0.93
Grain consumed:					
On the feed lot.....do....	6,130	5,170	5,979	5,356	4,809
Per pound of gain.....do....	5.49	6.12	5.67	4.70	5.89

MIXED-GRASS PASTURES FOR COWS.

OUTLINE OF THE EXPERIMENTS.

In 1916 three mixtures of pasture grasses were sown on 24 quarter-acre plats in field L–III. The three mixtures were planted in duplicate by each of four methods. The three mixtures and the rate of seeding for each are shown in Table XXII.

TABLE XXII.—*Pasture mixtures and rates of seeding in a method-of-seeding test on the Huntley Experiment Farm in 1918.*

Pasture mixture.	Rate per acre of seeding (pounds).		
	Mixture No. 1.	Mixture No. 2.	Mixture No. 3.
Awnless brome-grass	2	2	.....
Orchard grass	5	5	5
Tall fescue	3	3	3
Perennial rye-grass	3	3	.....
Kentucky bluegrass	4	4	4
White clover	2	.....	2
Alsike clover	2	.....	2
Seed per acre	21	17	16

In all cases the Kentucky bluegrass was seeded broadcast on April 2, 1917. The four methods of seeding employed for each mixture were as follows:

a. Spring seeded with a nurse crop of wheat cut for grain.
b. Spring seeded with a nurse crop of wheat cut for hay.
c. Spring seeded without a nurse crop.
d. Late summer seeded in wheat stubble.

TABLE XXIII.—*Weights of cows and comparisons of pasture mixtures on the Huntley Experiment Farm in 1918.*

Pasture mixture and name of cow.	Average weight (pounds).											
	May.		June.				July.					
	22,23,24.	28, 29.	4,5.	11, 12.	18, 19.	25, 26.	2, 3.	9, 10.	16, 17.	23, 24.	30, 31.	
Mixture 1:												
Corby [1]	1,147	1,096	1,139	1,203	1,091	1,138	1,151	1,179	1,172	1,149	1,197	
No. 211 [2]	1,045	1,035	1,060	1,092	1,102	1,089	1,068	1,099	1,092	1,090	1,006	
No. 216	755	763	792	815	823	816	835	884	856	859	882	
Midget	.....	.....	.....	1,150	1,204	1,205	1,225	1,261	1,265	1,249	1,278	
Total	2,947	2,894	2,991	4,260	4,220	4,248	4,279	4,423	4,385	4,347	4,362	
Average	982.3	964.7	997	1,065	1,055	1,062	1,069.8	1,105.8	1,096.3	1,086.8	1,090.5	
Mixture 2:												
No. 205	1,196	1,180	1,212	1,228	1,222	1,164	1,182	1,206	1,154	1,127	1,136	
No. 208	1,092	1,056	1,130	1,106	1,132	1,095	1,105	1,090	1,053	1,075	1,059	
No. 213	856	838	904	915	926	888	902	896	864	.....	864	
Queenie	.....	.....	.....	1,120	1,157	1,153	1,160	1,154	1,136	1,151	1,145	
Total	3,144	3,074	3,246	4,369	4,437	4,300	4,349	4,346	4,207	3,353	4,204	
Average	1,041.3	1,024.7	1,082	1,092.3	1,109.3	1,075	1,087.3	1,086.5	1,051.8	.....	1,051	
Mixture 3:												
Red [3]	.....	.....	.....	.....	.....	1,038	1,119	1,087	1,098	.....	.....	
No. 204 [4]	1,497	1,472	1,471	1,526	1,531	1,271	1,281	1,306	1,304	1,196	1,219	
No. 206	1,092	1,058	1,120	1,112	1,150	1,136	1,152	1,169	1,177	1,176	1,179	
No. 215	709	713	742	774	778	773	780	800	799	798	803	
Gussie	.....	.....	.....	966	1,020	1,004	1,004	1,032	1,025	1,007	1,025	
Total	3,298	3,243	3,333	4,378	4,479	4,184	4,217	4,307	4,305	4,177	4,226	
Average	1,099.3	1,081	1,111	1,099.5	1,119.8	1,046	1,054.3	1,076.8	1,076.3	1,044.3	1,056.5	

	August.				September.				October.			
	6, 7.	13, 14.	20, 21.	27, 28.	3, 4.	10, 11.	17, 18.	24, 25.	1, 2.	8, 9.	15, 16.	22, 23.
Mixture 1:												
Corby	1,190	1,156	1,190	1,161	1,195	1,229	1,231	1,221	1,251	1,239	1,267	1,294
No. 211	996	933	1,005	971	994	1,047	1,040	1,010	1,040	1,032	1,029	1,096
No. 216	894	861	934	921	950	984	993	1,000	1,019	1,021	1,040	1,050
Midget [5]	1,294	1,290	1,324	1,344	1,396	1,397	1,368	1,388	1,213	1,162	1,207	1,203
Total	4,374	4,240	4,453	4,417	4,535	4,657	4,632	4,619	4,523	4,454	4,606	4,643
Average	1,098.5	1,060	1,113.3	1,104.3	1,133.8	1,164.3	1,158	1,154.8	1,130.8	1,113.5	1,151.5	1,160.8
Mixture 2:												
No. 205	1,135	1,138	1,097	1,083	1,112	1,209	1,197	1,163	1,216	1,226	1,236	1,219
No. 208	1,063	1,077	1,087	1,090	1,092	1,136	1,146	1,123	1,161	1,169	1,167	1,210
No. 213	861	857	858	863	887	923	926	924	939	961	967	971
Queenie [6]	1,153	1,172	1,225	1,233	1,239	1,174	1,094	1,057	1,024	1,041	1,034	1,046
Total	4,212	4,244	4,267	4,269	4,330	4,442	4,363	4,267	4,340	4,397	4,404	4,446
Average	1,053	1,061	1,066.8	1,068.3	1,082.3	1,110.5	1,090.9	1,066.8	1,085	1,098.8	1,101	1,111.5
Mixture 3:												
No. 204	1,192	1,169	1,190	1,169	1,194	1,227	1,223	1,210	1,192	1,172	1,245	1,228
No. 206 [7]	1,216	1,200	1,219	1,222	1,227	1,264	1,267	1,258	1,286	1,993	1,321	1,172
No. 215	834	826	858	866	875	914	936	930	961	965	994	1,009
Gussie [8]	1,061	1,049	1,047	966	987	947	951	960	926	949	986	1,004
Total	4,303	4,244	4,314	4,223	4,283	4,352	4,377	4,358	4,365	4,379	4,546	4,413
Average	1,075.8	1,061	1,078.5	1,055.8	1,070.8	1,088	1,094.3	1,089.5	1,091.3	1,094.8	1,091.5	1,103.3

[1] Corby's udder was bruised on June 16, 1918.
[2] No. 211 calved on July 30, 1918.
[3] Red was substituted for No. 204, from July 2 to 16, inclusive.
[4] No. 204 calved on June 21, 1918.
[5] Midget calved on Sept. 28, 1918.
[6] Queenie calved on Sept. 10, 1918.
[7] No. 206 calved on Oct. 17, 1918.
[8] Gussie calved on Aug. 20, 1918.

In 1917 two crops of hay were harvested from each of the 24 plats. All the plats were irrigated uniformly three times during the season on June 30, July 23, and August 20.

During these first two years, 1916 and 1917, records were kept of the quantities of hay, grain, or grass harvested from the various plats of the three mixtures.

In 1918 another experiment was started, the object of which was to test the carrying capacity of the three pasture mixtures. For this experiment three pure-bred cows were placed on each mixture. Since the three mixtures had been planted in duplicate by each of the four methods, the groups of cows could be transferred from one lot to the other of the same mixture as the state of the pasture required.

Until early in September the plats were irrigated every time the cows were removed from one set of pasture lots to the other.

The cows placed on the pastures at the beginning of the experiment were pure-bred animals, but when the growth became too rank for the three cows to keep it grazed off, a grade animal was added to

FIG. 5.—Cows on mixed-grass pasture on the Huntley Experiment Farm in 1918. The view shows a portion of field A-II.

each group. The cows were weighed on three consecutive days at the beginning of the experiment and on two days of each week thereafter. An average of these two weighings was used as the weight for the week. The weights, included with the original data, are given in Table XXIII.

RESULTS OF THE TESTS.[1]

The object of this experiment was to test, during the pasture season, three mixtures of pasture grasses, to determine which is best suited for the heavy pasturing of dairy cattle. (Fig. 5.) The experiment is to be conducted for three consecutive summers. The following is an account of the experiment for the first year.

Two 1-acre lots were planted to each pasture mixture. These were designated as 1a and 1b, for mixture No. 1, and in the same manner

[1] Data digested and compiled by Bessie L. Collins, Cost of Milk Production Investigations, Bureau of Animal Industry.

for mixtures Nos. 2 and 3. Each lot consisted of four plats, each representative of one of the four methods which had been used in seeding the pasture mixtures.

Three cows were placed on each mixture on May 22 and alternated from one lot to the other of the same mixture. A fourth dry cow was added to each group on June 10, because the grass grew too rank for the three cows to keep it grazed off.

Pasture days and nights.—The actual number of days or nights one or more cows were on the pasture lots, from May 22 to October 12, inclusive, were counted as pasture days or nights. In the case of mixture No. 2 the cows were taken off pasture on October 2, as the grass was no longer sufficient, so there were 10 less pasture days for this than for mixtures Nos. 1 and 3. The cows were taken from the pasture at night, beginning on August 28.

Cow days and nights.—Each day that a cow was on pasture was counted as a pasture day. If three cows were on a lot one day, that lot was credited with three pasture days.

Each day that a cow was taken from pasture counted as a day off pasture. The cows were taken off during bad weather; and the cow Corby was taken off for 10 days, June 17 to 26, inclusive, on account of an injured udder.

Milking days.—Two cows on mixture No. 1 were producing milk during practically the entire pasture season, but the third cow was dry throughout the season. The fourth cow which was placed on each mixture from June 10 to August 22 was a dry cow in each case. On mixture No. 2 there were three milking cows, but they were taken from pasture and from the experiment 10 days earlier than were those on mixtures Nos. 1 and 3. On mixture No. 3 two cows were milking part of the season; the third was dry. Since there was such a variation in the number of milking cows, or the period of lactation, the actual number of days the cows on the various lots were milking were counted and credited to the lots as milking days.

Hay fed.—When the cows were off pasture they were fed alfalfa hay. The quantity fed was weighed and recorded. This hay was charged against the lots at $15 per ton.

Hay produced.—Hay was cut on each lot once during the season, and credited to the lot at $15 a ton. From mixtures Nos. 1 and 2 more hay was cut than was fed to the cows when off pasture, but on mixture No. 3 about 500 pounds more were fed than were cut.

Milk and butter fat.—Records were kept of the weight of milk produced each day. Mixture No. 1 shows a total for the season of 6,032.2 pounds; mixture No. 2, 8,083.2 pounds; and mixture No. 3, 5,175.5 pounds.

Butter-fat tests were made on two consecutive days of each week. A composite of the tests for these two days was used in computing

the butter fat for the week. The total yields of butter fat for mixtures Nos. 1, 2, and 3 were 210.07, 259.91, and 167.90 pounds, respectively.

Two butter-fat prices were quoted each week, and an average of these was used in computing the income from butter fat each week.

Skim milk.—No attempt was made to compute the skim milk by weeks, though this was done for the butter fat. The amount of skim milk was computed for each lot for the whole season, and the income was reckoned at a flat rate of 50 cents per 100 pounds.

Using lot 1*a* as an illustration, the skim milk was computed in the following manner:

The butter-fat test for the season was obtained by dividing the total number of pounds of milk (2,875.2) by the total number of pounds of butter fat (100.39). This gave a butter-fat test of 3.49 per cent. The weight of 30 per cent cream that would contain 3.49 pounds of butter fat was then obtained by dividing 3.49 by 0.30, or 11.6 pounds of cream. Then 100 pounds of milk testing 3.49 per cent butter fat was found to contain 11.6 pounds of cream, or 11.6 per cent cream and 88.4 per cent skim milk. By multiplying the number of pounds of milk (2,875.2) produced during the season by 88.4 per cent, the total number of pounds of skim milk (2,541.7) was obtained.

The same method of computing the number of pounds of skim milk was used for each of the other lots. Mixture No. 1 (lots *a* and *b*) was credited with 5,332.6 pounds; mixture No. 2 with 7,218.3 pounds; and mixture No. 3 with 4,616.3 pounds of skim milk.

Solids in milk, lactometer readings.—Lactometer readings were made the same two days of each week that the butter-fat tests were made. The percentage of solids was tabulated from the lactometer and butter-fat records for the two days, and composites were figured. These were used in computing the solids for each week for the separate lots. The milk credited to mixture No. 1 contained 705.9 pounds of solids and to mixtures Nos. 2 and 3, 925.5 and 555.1 pounds, respectively.

Income from butter fat, skim milk, and hay.—That a comparison might be made of the three pasture mixtures, not only for the butter fat and skim milk produced, but also for the hay cut, the incomes from butter fat, skim milk, and hay cut were added for each of the mixtures. From these figures the value of the hay fed was subtracted in order to obtain the net income from the butter fat, skim milk, and hay cut.

The net income from mixture No. 2 ($159.19) was higher than for mixture No. 1 ($134.51) or mixture No. 3 ($92.89), but it was necessary to remove the cows from the pasture 10 days before they were taken from mixtures Nos. 1 and 3.

TABLE XXIV.—*Comparison of three pasture mixtures on the Huntley Experiment Farm in 1918.*

Pasture mixture.	Pasture.		Cow.					Hay fed.		Hay produced.		
			On pasture.		Off pasture.		Number of milking days.					
	Days.	Nights.	Days.	Nights.	Days.	Nights.		Pounds.	Value at $15 per ton.	Date harvested.	Pounds.	Value at $15 per ton.
No. 1:												
a	69	50	244	187	1	21	169	925	$6.94	May 22.	1,468	$11.01
b	66	42	225	153	18	41	150	2,025	15.19	June 5..	3,880	29.10
Total	135	92	469	340	19	62	319	2,950	22.13	.....	5,348	40.11
Average	67.5	46	234.5	170	9.5	31	159.5	1,475	11.06	.....	2,674	20.05
No. 2:												
a	70	53	246	195	3	20	219	1,034	7.76	May 22.	1,640	12.30
b	55	39	193	145	6	22	183	1,196	8.97	June 5..	2,640	19.80
Total	125	92	439	340	9	42	402	2,230	16.73	.....	4,280	32.10
Average	62.5	46	219.5	170	4.5	21	201	1,115	8.36	.....	2,140	16.05
No. 3:												
a	72	54	256	204	4	22	87	1,366	10.24	May 22.	1,415	10.61
b	63	38	222	146	6	30	83	1,694	12.71	June 5..	1,140	8.55
Total	135	92	478	350	10	52	170	3,060	22.95	.....	2,555	19.16
Average	67.5	46	239	175	5	26	85	1,530	11.48	.....	1,278	9.58

Pasture mixture.	Milk produced (pounds).				Value.				Net income.
							Total.		
	Total.	Solids.	Butter fat.	Skim milk.	Butter fat.	Skim milk.	Butter fat and skim milk.	Butter fat, skim milk, and hay cut.	
No. 1:									
a	2,875.2	337.1	100.39	2,541.7	$42.79	$12.71	$55.50	$66.51	$59.57
b	3,157.1	368.8	109.68	2,790.9	47.08	13.95	61.03	90.13	74.94
Total	6,032.3	705.9	210.07	5,332.6	89.87	26.66	116.53	156.64	134.51
Average	3,016.2	352.9	105.04	2,666.3	44.94	13.33	58.27	78.32	67.26
No. 2:									
a	4,339.2	495.7	138.26	3,879.2	57.33	19.40	76.73	89.03	81.27
b	3,744.0	429.8	121.65	3,339.6	50.40	16.69	67.09	86.89	77.92
Total	8,083.2	925.5	259.91	7,218.3	107.73	36.09	143.82	175.92	159.19
Average	4,041.6	462.7	129.96	3,609.1	53.86	18.05	71.91	87.96	79.60
No. 3:									
a	2,796.0	299.1	91.00	2,494.0	39.48	12.47	51.95	62.56	52.32
b	2,379.5	256.0	76.90	2,122.5	34.12	10.61	44.73	53.28	40.57
Total	5,175.5	555.1	167.90	4,616.5	73.60	23.08	96.68	115.84	92.89
Average	2,587.8	277.6	83.95	2,308.3	36.80	11.54	48.34	57.92	46.44

One reason for the higher net income from mixture No. 2 may be that the original three cows placed on this mixture were milking when placed on pasture and throughout the period in which they were on the pasture, making a total of 402 milking days. Only two of the three cows placed on mixture No. 1 were milking, the third remaining dry throughout the pasture season. This made a total of 319 milking days for mixture No. 1. Of the three cows placed on mixture No. 3 at the beginning of the season, only one was milking,

and that one went dry on July 19. A second freshened on June 21, but the third remained dry throughout the season. So this mixture received credit for 170 milking days, as compared with 402 days for mixture No. 2 and 319 days for mixture No. 1.

Mixture No. 3 carried the cows through the entire period of the experiment, but less hay was cut than from either of the other mixtures. From mixture No. 3 only 2,555 pounds were cut; from mixture No. 1, 5,348 pounds, and from mixture No. 2, 4,280 pounds, though it would not maintain the cows during the last 10 days of the experiment.

The variation in income from the three mixtures, then, may have been due to the difference in the pasture mixtures or to the unequal number of dry cows placed on the mixtures. (Table XXIV.)

VARIATION IN WEIGHT OF THE COWS ON THE MIXTURES.

The three pure-bred Holstein cows placed on each mixture were weighed on May 22, 23, and 24 and on two consecutive days of each following week. The average of the weights for the first three days was used as the initial weight and the average of the two days in each week thereafter as the weight for that week. On June 12 a grade cow was added to each pasture mixture. The average of the weights for June 11 and 12 was used as the first weight of each of these cows.

From Table XXV it will be seen that all the cows but one on mixture No. 1 gained in weight. The average weight for the three pure-bred cows upon entering the experiment was 982.3 pounds, but it increased to 1,097.3 pounds by October 12, making an average increase of 115 pounds per cow. But during the period from June 12 to August 28 the average gain in weight of each cow in the group, which then included the grade cow, was only 39.3 pounds.

Each cow on mixture No. 2 showed an increase in weight, making an average increase of 64 pounds per cow for the three pure-bred cows. The fluctuations in weight during the period of the experiment caused the four cows to show an average decrease of 39.3 pounds per cow from June 12 to August 8.

Owing to the decrease of 325 pounds in the weight of cow No. 204, the average increase for the three pure-bred cows on mixture No. 3 was only 44 pounds. For the same reason the group of three cows showed an average decrease in weight of 43.7 pounds per cow from June 12 to August 28.

The next to the last column in Table XXV indicates the stage of lactation and is given for use in comparing the weights of the various cows. The terms first, middle, last, and dry were used to indicate the period directly after freshening, from then to six months after freshening, more than six months in milk, and the period that a cow was actually dry.

TABLE XXV.—*Breed, weight, and stage of lactation of cows in the pasture experiment on the Huntley Experiment Farm in 1918.*

Pasture, mixture, and name of cow.	Breed.	First weights taken.		Last weights taken.		Time between first and last weights.	Stage of lactation.	Difference in average weights.
		Date.	Average.	Date.	Average.			
Mixture 1:			*Pounds.*		*Pounds.*	*Days.*		
Corby	Pure-bred Holstein.	May 22, 24	1,147	Oct. 8, 9	1,239	141	Middle, last.	92
No. 211	do	do	1,045	do	1,032	141	Last, dry, first.	− 13
No. 216	do	do	755	do	1,021	141	Dry	266
Midget	Grade	June 11–12	1,150	Aug. 27, 28	1,344	79	do	194
Average	3 pure bred	May 22, 24	982.3	Oct. 8, 9	1,097.3	141		115.0
	All 4 cows	June 11, 12	1,065	Aug. 27, 28	1,104.3	79		39.3
Mixture 2:								
No. 205	Pure-bred Holstein.	May 22, 24	1,196	Oct. 1, 2	1,216	134	Last	20
No. 208	do	do	1,092	do	1,161	134	First	69
No. 213	do	do	856	do	939	134	Middle	83
Queenie	Grade	June 11, 12	1,120	Aug. 6, 7	1,153	58	Dry	33
Average	3 pure bred	May 22, 24	1,041.3	Oct. 1, 2	1,105.3	134		64.0
	All 4 cows	June 11, 12	1,092.3	Aug. 6, 7	1,053	58		− 39.3
Mixture 3:								
No. 204	Pure-bred Holstein.	May 22, 24	1,497	Oct. 8, 9	1,172	141	Dry, first	−325
No. 206	do	do	1,092	do	1,293	141	Last, dry	201
No. 215	do	do	709	do	965	141	Dry	256
Gussie	Grade	June 11, 12	966	Aug. 27, 28	966	79	do	
Average	3 pure bred	May 22, 24	1,099.3	Oct. 8, 9	1,143.3	141		44.0
	All 4 cows	June 11, 12	1,099.5	Aug. 27, 28	1,055.8	79		− 43.7

PASTURING SHEEP.

A pasture carrying-capacity test with sheep that was begun in 1917 on four quarter-acre plats of mixed grasses in field B–V was continued in 1918. These pastures were seeded in 1915 to the following grass mixture: Awnless brome-grass, orchard grass, meadow fescue, Kentucky bluegrass, perennial rye-grass, tall fescue, and white clover.

On April 24 six ewes and their lambs were placed on this pasture. The four plats were pastured in rotation, in periods of four to five days. Each part of the pasture was irrigated as soon as the sheep were removed. The six ewes and lambs on September 10 were replaced by 10 yearling and 2-year-old ewes that remained on the pasture until October 21.

The pasture was slightly overgrazed during the first month of the season, but from the latter part of May to the end of the pasture period it produced sufficient grazing to carry the sheep in good condition. The ewes made a total gain of 66 pounds and the lambs a total gain of 314 pounds. The 10 ewes that were placed on the pasture on September 18 did not gain in weight, but they were maintained in good condition to the end of the pasture period.